CLAIMS

We claim:

1. A method of making an aqueous dispersion, comprising

providing a polymer (a) comprising at least one water dispersible group per molecule and one or more functional groups (f) reactive with crosslinking agent (b),

providing at least one crosslinking agent (b) comprising one or more blocked functional groups (f_b) that are reactive with polymer (a) after unblocking, wherein crosslinking agent (b) has a T_g of from 40 to 70°C/105 to 158°F and is a solid at 23.9°C/75°F when at 100% by weight solids,

mixing crosslinking agent (b) into polymer (a) at a temperature that is at or above the melting temperatures of both polymer (a) and compound (b) but which is below the temperature at which blocked functional groups (f_b) unblock, so as to provide a melt-mixture (ii), and

adding a sufficient amount of water to the melt-mixture (iii) so as to provide an aqueous dispersion.

2. The method of claim 1 wherein the at least one water dispersible group is a nonionic group.

3. The method of claim 1 wherein the at least one water dispersible group is a saltable group or a precursor saltable group.

4. The method of claim 3 further comprising adding at least one salting agent into the melt-mixture (ii) so as to form one or more salted sites per molecule of polymer (a) to create a salted melt-mixture (iii) wherein the sufficient amount of water is added to the salted melt-mixture (iii) so as to provide an aqueous dispersion.

5. The method of claim 4 wherein the aqueous dispersion is electrodepositable.

6. The method of claim 1 wherein polymer (a) comprises a polymer selected from the group consisting of polyurethane polymers, acrylic polymers, epoxy based polymers and mixtures thereof.

7. The method of claim 3 wherein polymer (a) is an acrylic polymer.

8. The method of claim 7 wherein the aqueous dispersion has no more than 5% by weight nonvolatile of an epoxy functional polymer, based on the total nonvolatile weight of polymer (a) and crosslinking agent (b).

9. The method of claim 7 wherein providing polymer (a) comprises providing a mixture (i) comprising polymer (a) and one or more polymerization solvents, said mixture (i) having a solids content of at least 50 % by weight, based on the total weight of mixture (i).

10. The method of claim 9 wherein mixture (i) has a solids content of at least 70.0% by weight, based on the total weight of mixture (i).

11. The method of claim 10 wherein mixture (i) has a solids content of at least 90.0% by weight, based on the total weight of mixture (i).

12. The method of claim 11 wherein mixture (i) has a solids content of at least 99.0% by weight, based on the total weight of mixture (i).

13. The method of claim 9 wherein the aqueous dispersion comprises the one or more polymerization solvents of mixture (i).

14. The method of claim 13 further comprising removing at least a portion of said polymerization solvents from the dispersion to provide a dispersion having less than 5.0% by weight of polymerization solvents, based on the total weight of the aqueous dispersion.

15. The method of claim 14 further comprising removing an amount of said polymerization solvents from the dispersion to provide a dispersion having less than 1.0% by weight of polymerization solvents, based on the total weight of the aqueous dispersion.

16. The method of claim 15 further comprising removing an amount of said polymerization solvents from the dispersion to provide a dispersion having less than 0.5% by weight of polymerization solvents, based on the total weight of the aqueous dispersion.

17. The method of claim 1 wherein the dispersion has an average particle size of from 0.05 to 0.50 microns.

18. The method of claim 1 comprising providing a polymer (a) having a solids content of at least 70.0% by weight nonvolatile based on the total weight of polymer (a).

19. The method of claim 18 wherein polymer (a) has a solids content of at least 80.0% by weight nonvolatile based on the total weight of polymer (a).

20. The method of claim 19 wherein polymer (a) has a solids content of at least 90.0% by weight nonvolatile based on the total weight of polymer (a).

21. The method of claim 20 wherein polymer (a) has a solids content of at least 99.0% by weight nonvolatile based on the total weight of polymer (a).

22. The method of claim 18 wherein the step of providing a polymer (a) of at least 70.0 % solids further comprises

polymerizing one or more polymerizable monomers in one or more polymerization solvents, wherein at least one monomer comprises an saltable group or a precursor saltable group, so as to form a mixture (i) comprising said polymerization solvents and a polymer (a) comprising one or more saltable groups or precursor saltable groups,

removing at least a portion of said polymerization solvents from the mixture (i) to provide a mixture (i) having a solids content of at least 70% by weight solids, based on the total weight of mixture (i).

23. The method of claim 22 wherein the polymerizable monomers are ethylenically unsaturated monomers and the polymer (a) is an acrylic polymer.

24. The method of claim 3 wherein polymer (a) has from 0.2 to 3.0 mEQ saltable sites/gram NV polymer (a).

25. The method of claim 24 wherein polymer (a) has from 0.4 to 2.0 mEQ saltable sites/gram NV polymer (a).

26. The method of claim 25 wherein polymer (a) has from 0.6 to 0.9 0 mEQ saltable sites/gram NV polymer (a).

27. The method of claim 4 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 20 to 100 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

28. The method of claim 27 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 40 to 80 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

29. The method of claim 28 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 55 to 65 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

30. The method of claim 4 wherein the salted polymer (a) has from 0.5 to 8.0 mEQ OH/gram NV of polymer (a).

31. The method of claim 30 wherein the salted polymer (a) has from 1.5 to 6.0 mEQ OH/gram NV of polymer (a).

32. The method of claim 31 wherein the salted polymer (a) has from 2.5 to 4.5 mEQ OH/gram NV of polymer (a).

33. The method of claim 7 wherein acrylic polymer (a) has from 0.6 to 0.9 mEQ saltable sites/gram NV acrylic polymer (a), from 2.5 to 4.5 mEQ OH/ grams NV acrylic polymer (a) and from 55 to 65% of the saltable sites are neutralized by the addition of the at least one salting agent.

34. A method of making an aqueous electrodepositable dispersion, comprising

polymerizing one or more ethylenically unsaturated monomers in one or more polymerization solvents, wherein at least one of the ethylenically unsaturated monomers contains an saltable group or a precursor saltable group, so as to form a mixture (i) comprising said polymerization solvents and an acrylic polymer (a) comprising one or more saltable groups or precursor saltable groups,

removing at least a portion of said polymerization solvents from mixture (i) to provide a mixture (i) having a solids content of at least than 50% by weight solids and comprising acrylic polymer (a), based on the total weight of mixture (i),

providing at least one crosslinking agent (b) comprising one or more blocked functional groups (f_b) that are reactive with acrylic polymer (a) after unblocking, wherein crosslinking agent (b) has a T_g of from 40 to 70°C/105 to 158°F and is a solid at 23.9°C/75°F when at 100% nonvolatile,

mixing crosslinking agent (b) into mixture (i) at a temperature which is at or above the melting temperature of both acrylic polymer (a) and crosslinking agent (b) but which is below the temperature at which blocked functional groups (f_b) unblock, so as to provide a melt-mixture (ii),

adding at least one salting agent into the melt-mixture (ii) so as to form one or more salted sites per molecule of acrylic polymer (a) to create a salted melt-mixture (iii) and

adding a sufficient amount of water to the salted melt-mixture (iii) so as to provide an aqueous electrodepositable dispersion.

35. The method of claim 34 wherein acrylic polymer (a) comprises one or more precursor saltable sites.

36. The method of claim 35 further comprising reacting the one or more saltable precursor sites with at least one conversion compound to produce one or more saltable sites.

37. The method of claim 34 wherein acrylic polymer (a) comprises one or more cationic saltable sites.

38. The method of claim 34 wherein acrylic polymer (a) comprises one or more cationic precursor saltable sites.

39. The method of claim 38 wherein the one or more cationic precursor saltable sites are epoxy groups.

40. The method of claim 39 wherein the epoxy groups are reacted with an secondary amine group to form a tertiary amine group.

41. The method of claim 37 wherein the step of adding a sufficient amount of a salt forming compound comprises adding a sufficient amount of an acidic compound.

42. The method of claim 34 wherein acrylic polymer (a) comprises one or more anionic salting sites.

43. The method of claim 42 wherein the step of adding a sufficient amount of a salt forming compound comprises adding a sufficient amount of an basic compound.

44. The method of claim 34 wherein the aqueous electrodepositable dispersion has an average particle size of from 0.05 to 0.50 microns.

45. The method of claim 44 wherein the aqueous electrodepositable dispersion has an average particle size of from 0.10 to 0.40 microns.

46. The method of claim 45 wherein the aqueous electrodepositable dispersion has an average particle size of from 0.20 to 0.35 microns.

47. The method of claim 34 comprising removing sufficient polymerization solvent so as to provide a mixture (ii) having at least 70 % by weight solids.

49. The method of claim 47 comprising removing sufficient polymerization solvent so as to provide a mixture (ii) having at least 70 % by weight solids.

49. The method of claim 34 wherein at least one crosslinking agent (b) comprises at least two or more blocked isocyanate groups.

50. The method of claim 49 wherein the one or more isocyanate groups are blocked with e-caprolactam.

51. The method of claim 34 wherein at least one crosslinking agent (b) has a T_g of from 30 to 90°C/86 to 194°F.

52. The method of claim 51 wherein at least one crosslinking agent (b) has a T_g of from 40 to 70°C/105 to 158°F.

53. The method of claim 34 wherein polymer (a) has from 0.2 to 3.0 0 mEQ saltable sites/gram NV polymer (a).

54. The method of claim 53 wherein polymer (a) has from 0.4 to 2.0 0 mEQ saltable sites/gram NV polymer (a).

55. The method of claim 54 wherein polymer (a) has from 0.6 to 0.9 0 mEQ saltable sites/gram NV polymer (a).

56. The method of claim 34 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 20 to 100 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

57. The method of claim 56 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 40 to 80 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

58. The method of claim 57 wherein the step of adding at least one salting agent to the melt-mixture (ii) comprises adding sufficient salting agent so as to salt from 55 to 65 % of the saltable sites on polymer (a), based on the total number of saltable sites of polymer (a).

59. The method of claim 34 wherein the salted polymer (a) has from 0.5 to 8.0 mEQ OH/gram NV of polymer (a).

60. The method of claim 59 wherein the salted polymer (a) has from 1.5 to 6.0 mEQ OH/gram NV of polymer (a).

61. The method of claim 60 wherein the salted polymer (a) has from 2.5 to 4.5 mEQ OH/gram NV of polymer (a).

62. The method of claim 34 wherein acrylic polymer (a) has from 0.6 to 0.9 mEQ saltable sites/gram NV acrylic polymer (a), from 2.5 to 4.5 mEQ OH/ grams NV acrylic polymer (a) and from 55 to 65% of the saltable sites are neutralized by the addition of the at least one salting agent.

63. A method of making an aqueous electrodepositable dispersion, comprising

polymerizing one or more ethylenically unsaturated monomers in one or more polymerization solvents, wherein at least one of the ethylenically unsaturated monomers contains a saltable site or a precursor saltable site, so as to form a mixture (i) comprising said polymerization solvents and an acrylic polymer (a) comprising one or more cationic salting sites,

removing at least a portion of said organic solvents from mixture (i) to provide a mixture (i) having a solids content of at least 70% by weight solids and consisting of acrylic polymer (a), based on the total weight of mixture (i),

providing at least one crosslinking agent (b) comprising one or more blocked functional groups (f_b) that are reactive with acrylic polymer (a) after unblocking, wherein crosslinking agent (b) has a T_g of from 40 to 70°C/105 to 158°F and is a solid at 23.9°C/75°F when at 100% nonvolatile,

mixing compound (b) into mixture (i) at a temperature which is at or above the melting temperature of both acrylic polymer (a) and crosslinking agent (b) but which is below the temperature at which blocked functional groups (f_b) unblock, so as to provide a melt-mixture (ii),

adding a sufficient amount of an acidic compound and water to the melt-mixture (ii) so that acrylic polymer (a) disperses crosslinking agent (b) into the water so as to provide an aqueous electrodepositable dispersion.

64. The method of claim 63 wherein acrylic polymer (a) comprises one or more amine groups or groups convertible to amine groups.

65. The method of claim 63 wherein acrylic polymer (a) comprises one or more epoxy groups.

66. The method of claim 64 further comprising adding a secondary amine to mixture (ii) so as to convert the epoxy groups of acrylic (a) to tertiary amine groups.